A·I·B·S

bulletin

NEWS AND VIEWS IN THE BIOLOGICAL SCIENCES

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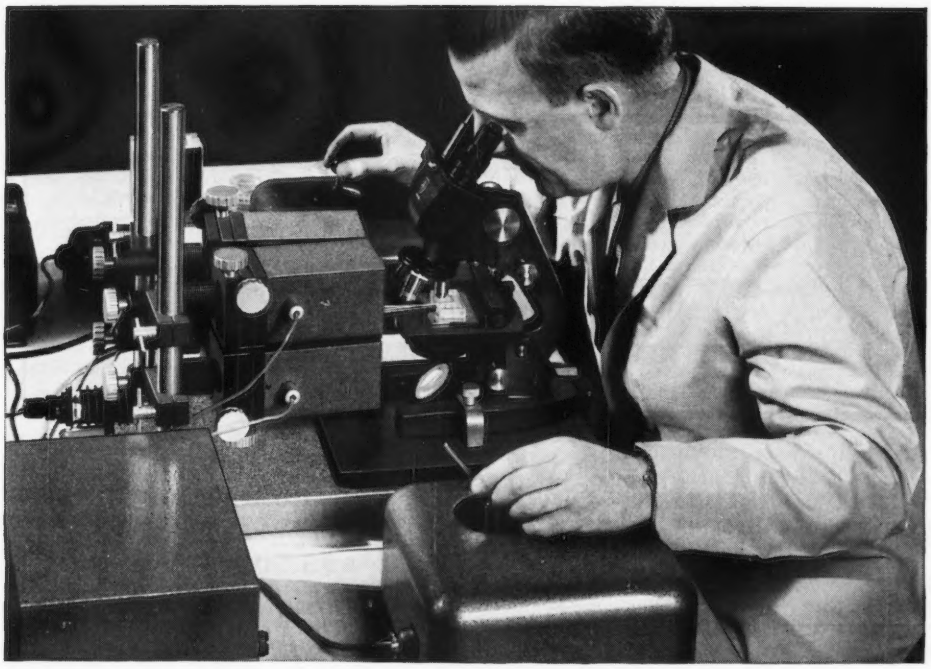

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"The Valor of Teaching"

IN a recent issue of *The Atlantic Monthly* a pertinent tribute was paid to the teaching profession by Agnes de Mille, noted dancer, choreographer and author. She chose to call her article "The Valor of Teaching."

In addition to discussing the dedication of those who transmit ideas, Miss de Mille wrote: "Teachers teach because they like the life and because they believe in what they are doing. And what do we pay them for these unique offices? Less, of course, than we pay anyone else of comparable ability. Now, although they seem willing enough to work without recompense, it is manifestly not only unfair but risky to ask them to continue doing so however idealistic they may profess themselves. They have families, and with all the highmindedness in the world they cannot curtail their children's comfort and security." And she continued, "The kind of mind and point of view and discipline that makes a great pedagogue can be well used in commercial fields. Our finest practitioners in a special and difficult art will be tempted away, and once our faculties diminish in quality, the student will follow suit immediately. And that will be the end of us."

Miss de Mille is obviously one of a large group of educators, thinkers, citizens and parents who are deeply concerned about the state of our educational system. They are particularly concerned about the impending shortage of able teachers. What is the true nature of the situation? What can be done about it?

As biologists our concern is two-fold—the general teacher shortage and the science teacher shortage. The latter should claim our particular attention.

That a general scientific manpower shortage exists in the U.S.A. has now been officially acknowledged. Figures coming from behind the Iron Curtain only emphasize the situation. Since its formation in 1948 the A.I.B.S. has been actively involved in manpower problems. During the last two years the Institute has been represented on the Scientific Manpower Commission and, through a contract with the National Science Foundation, is preparing the major part of the biological section of the National Register of Scientific and Technical Personnel. These are eminently worthwhile undertakings. But they do not allow for participation by the individual biologist. So much of the work to be done must be done at the *grassroots* level, in the *community*, through *individual* and *group* effort.

Since knowledge must precede action, we hope to use the pages of the *AIBS Bulletin* to present accurate data about the scientific manpower situation generally, about the biological sciences in particular, about the problems to be solved in education, and the projects and plans that have been suggested or tried to alleviate the situation.

At an April meeting of the AIBS Governing Board a Committee on Education and Professional Recruitment was formed. It will function as a clearing house for ideas in biological education, will cooperate with other organizations in eliminating duplication of effort, and will seek to support worthwhile studies or remedial programs.

In this issue of the *Bulletin*, Dr. Dael Wolfle discusses the *supply* of biologists and Dr. Howard Meyerhoff, the *demand* for biologists. Both subjects are basic to further discussion. Both men are in a position to offer the best figures available.

In future issues of the *Bulletin*, a column called "Biological Education" will appear. It will carry descriptions of projects, large and small; reports of conferences and studies; references to teacher aids; ideas and projects for community effort; current statistics; and estimates of achievement in the "battle" for a sufficient number of well-qualified, properly-paid, and enthusiastic science teachers.

Across the Editor's Desk

• **The National Academy of Sciences has announced that it will undertake a broad appraisal of present knowledge about the effects of atomic radiation on living organisms** and will seek to emphasize the areas in which further intensive research is urgently needed. The study will receive the financial support of the Rockefeller Foundation and the full cooperation of the U. S. Atomic Energy Commission. Such problems as defense against radioactive fallout cannot be adequately undertaken until the whole picture of radiation effect is brought into focus. An appraisal of the state of medical knowledge regarding therapy and protection is planned as well as an evaluation of the availability of information to scientists, physicians, and the general public.

• **During the 92nd Annual Meeting of the National Academy of Sciences, April 25-27, the following medals were awarded:**

The Alexander Agassiz Medal, established to honor outstanding contributors to the science of oceanography throughout the world, was awarded to *W. Maurice Ewing*, Professor of Geology at Columbia University, for his work in marine geophysics.

The Elliot Medal awarded for the most meritorious work published each year in zoology or paleontology was presented to *Libbie H. Hyman*, Research Associate of the American Museum of Natural History, New York. Dr. Hyman received the award for her two volumes, appearing in 1951, as parts of a treatise on *The Invertebrates.*

The Kimber Genetics Award, presented for the first time this year, is given to recognize distinguished scientific contributions in the field of genetics, either through single accomplishments or a long period of significant productivity. *William E. Castle*, Emeritus Professor of Genetics at Harvard University and *Herman J. Muller*, Professor of Zoology at Indiana University were recipients of this medal.

Newly elected members of the Academy include the following biologists: Lawrence R. Blinks, Stanford University; Ralph W. Gerard, University of Illinois; Johannes Holtfreter, University of Rochester; Colin M. McLeod, New York University College of Medicine; Horace W. Magoun, University of California Medical Center; Robley C. Williams, University of California; David W. Wilson, University of Pennsylvania; and Perry W. Wilson, University of Wisconsin. Among the Foreign Associates elected to membership in the Academy was Andre Lwoff, Dept. of Microbial Physiology, Institut Pasteur, Paris, France.

• **Four Merck Senior Postdoctoral Fellowships in the Natural Sciences** for 1955-56 have been awarded by the National Academy of Sciences-National Research Council. Three biologists were among the recipients: *Harlyn O. Halvorson*, University of Michigan, who will do research in microbiology at the Institut Pasteur; *Clifford R. Stocking*, University of California, Davis, who will devote his fellowship year to research in plant physiology at the University of Wisconsin; and *David W. Weiss*, Rockefeller Institute, who will do research in microbiology at Oxford University, England.

• **Two biologists are among the winners of Lilly Research Postdoctoral Fellowships in the Natural Sciences,** according to an announcement of the National Academy of Sciences-National Research Council. *Robert G. Stanley*, University of California, will spend his year in research in forest physiology

at the Institute of Forest Genetics, U. S. Forest Service. *Jacob F. Woessner, Jr.*, Massachusetts Institute of Technology, will work in biochemistry at the University of Pennsylvania.

• **Karl S. Lashley,** who first demonstrated a measurable relationship between brain mass and learning ability, will retire this summer as Research Professor of Neuropsychology at Harvard University. Since 1942 Dr. Lashley has been Director of the Yerkes Laboratories of Primate Biology at Orange Park, Florida, a research center under the joint sponsorship of Harvard and Yale Universities.

• **The Council of Participating Institutions of Argonne National Laboratory will sponsor a conference on the Use of Isotopes in Agriculture, January 12-14, 1956, at Michigan State College, East Lansing, Michigan.** Coordinated with this the AAAS and the Oak Ridge Institute of Nuclear Studies will sponsor a related conference on Atomic Energy and Agriculture at the Atlanta, Ga., meeting of the AAAS, December 26-30, 1955.

At the East Lansing meeting laboratory problems, experimental problems and results will be covered. There will be half-day sessions devoted to invited papers on (a) Waste Disposal, (b) Radiobiological Studies, (c) New Techniques in Tracer Use, (d) Herbicides and Fungicides, (e) Food Preservation, (f) Mineral Uptake in Plants, (g) Nitrogen and Organic Matter Transformations in Soils, and (h) Lactation. There will also be half-day sessions for contributed papers in the fields of (a) Mineral Metabolism of Animals, (b) Plant Nutrition and Fertilizer Utilization, (c) Translocation and Metabolism of Organic Plant Constituents, (d) Biological Modification and Response Induced by Ionizing Radiation, (e) Thyroid Function in Domestic Animals, (f) Sulfur Metabolism, and (g) Metabolism of Calcium and other Bone-seeking Elements. Titles and 300-word abstracts of contributed papers should be sent to: *E. W. Phelan, Argonne National Laboratory, Box 299, Lemont, Illinois.* To be included in the program, they must be received by October 15, 1955.

• **The Weed Society of America was founded at Fargo, N. D., on December 8, 1954.** This Society grew out of the action of the Association of Regional Weed Control Conferences. It was decided that all persons who joined the new society during the calendar year of 1955 would become charter members and that a permanent constitution would be considered at the 1956 meeting. The membership is open to individuals and organizations of all nations. Membership dues are $6.00 for 1955, which includes a subscription to the journal, *Weeds.* All persons interested in becoming charter members should contact *Dr. W. C. Jacobs, Ill. Agric. Exper. Station, Urbana, Illinois.* All members interested in publishing papers in *Weeds* should send manuscripts to Dr. K. P. Buchholtz, Editor, Dept. of Anatomy, University of Wisconsin, Madison, Wis.

• **The Texas Research Foundation recently awarded gold medals and $10,000** to a Colorado soil scientist and two Texas plant breeders for their scientific contributions to agriculture. *Sterling R. Olsen,* Colorado A & M received the Hoblitzelle National Award, $5000 and a gold medal, for his chemical research which culminated in the development of a better method for the measurement of phosphorus in soils. *John R. Quinby* and *Joseph C. Stephens* of the Texas Agric. Exper. Station at Chillicothe received the Hoblitzelle Achievement Award for the Advancement of Texas Rural Life, $5000 and a gold medal each, for their work in developing a practical method for the commercal production of hybrid sorghum seed.

• **Twenty-seven biochemists received grants to assist their travel to the 3rd International Congress of Biochemistry,** to be held in Brussels, Belgium, August 1-6, 1955. Eighteen of the awards were made by the National Science Foundation, seven by the American Soc. of Biological Chemists, and two, given as memorials to the late Erwin Brand, by the Div. of Biological Chemistry of the American Chemical Society. The three organizations awarded their grants as a collaborative enterprise. The following scientists are recipients of these grants: Roscoe O. Brady, Paul L. Day, Alexander L. Dounce, Harold Edelhoch, Sidney W. Fox, Philip Handler, Frederic L. Hoch, Patricia J. Keller, Lloyd M. Kozloff, Henry R. Mahler, Frank M. Mallette, Lester J. Reed, Sidney Roberts, Walter C. Schneider, Dewitt Stetten, Jr., Virginia R. Williams, John L. Wood, Willis A. Wood, Bernard Axelrod, Robert K. Crane, David G. Doherty, G. Robert Greenberg, Mary Ellen Jones, W. Wayne Kielley, and Joseph Larner. The Erwin Brand Memorial Awards were given to Sidney Shulman and Thomas R. Riggs.

• **The Chemical-Biological Coordination Center** (National Research Council, 2101 Constitution Avenue, Washington 25, D. C.) **has prepared a pamphlet, "Types of Questions Answered by the CBGG with Specific Examples,"** which may be obtained by writing to Dr. G. Congdon Wood, Head, Biology Group, at above address.

• **An invitational conference on Recent Advances in the Physiology of the Invertebrates,** sponsored by the National Science Foundation, the Tektronix Foundation, and the University of Oregon, will be held at Eugene, Oregon, from September 12-16, 1955. The conference will consist of reviews of recent work in invertebrate physiology, followed by informal discussions. A visit to the Oregon Institute of Marine Biology at Charleston is planned. The papers presented at the conference will be published by the University of Oregon Press. Invited speakers will include A. W. Martin, L. K. Kleinholz, B. T. Scheer, T. H. Bullock, F. A. Brown, Jr., J. S. Pringle, J. D. Robertson, T. H. Waterman, C. A. G. Wiersma, K. M. Wilbut, and others. A limited number of accommodations will be available to persons interested in the conference, who should write to: *B. T. Scheer, Dept. of Biology, University of Oregon, Eugene,* for further details.

• **The Research Committee of the Zoological Society of San Diego, announces the continuing Robert P. Scripps Fellowship available to graduate or post-doctoral students for research in animal biology.** Problems may be undertaken in pathology, bacteriology, parasitology, physiology, comparative anatomy, comparative biochemistry, animal nutrition, veterinary medicine or animal psychology. The stipend is $2000 and $500 for research expenses. Applications, furnishing full information regarding academic preparation, degrees, and specific field of proposed research, should be addressed to Dr. Anthony W. Sylstra, Secretary, Research Committee, Zoological Society of San Diego, Box 551, San Diego 12, Calif.

The Biological Research Institute is housed in the Hospital of the San Diego Zoological Gardens. Facilities include a two-story building with well equipped individual laboratories, and operating room and offices. Extensive outdoor animal isolation quarters adjoin the building. Members of the Research Committee of the Institute are available for counsel and assistance.

From the Societies

• **The National Association of Biology Teachers has elected the following officers for 1955:** President: Brother Charles, St. Mary's College, Winona, Minn.; President-Elect: John P. Harrold; First Vice-President: Edna Higbee; Second Vice-President: Enid A. Larson; Secretary-Treasurer: Paul V. Webster, Bryan City Schools, Bryan, Ohio.

A North Central Conference on Biology Teaching, sponsored by the NABT on a grant from the National Science Foundation, will be held August 19-30, 1955, at Michigan Biological Station, Douglas Lake, Mich. Those who will attend will be persons involved in the training of biology teachers in colleges and universities, public and private school teachers of life sciences, school and college administrators, representatives of state departments of education, and outstanding biologists. Participants will be selected from Michigan, Ohio, West Virginia, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, and Kansas. The Conference staff is composed of: Richard L. Weaver, Director; John Breukelman, Richard R. Armacost, Paul Klinge, and Alfred H. Stockard.

• At the annual meeting of the **Association of Southeastern Biologists,** held in Charleston, S. C., April 21-23, **the following officers were elected:** President: Alvin B. Beatty, Emory University: President-Elect: George C. Kent, Jr.; Vice-President: A. J. Sharp; Treasurer: J. P. Reynolds; Secretary: J. C. Dickinson, Department of Biology, University of Florida. The Society will meet with the AAAS at Atlanta, Ga., in December 1955.

The A.I.B.S. Reports

• **The AIBS Advisory Committee on Physiology to the Office of Naval Research** met April 15, 1955 at San Francisco, Calif. Five research proposals were evaluated by the Committee. Dr. Joseph Lilienthal is Chairman of this Committee.

• On April 10, 1955, the **AIBS Advisory Committee on Biochemistry to the Office of Naval Research,** met in San Francisco, Calif. This group, under the chairmanship of Dr. Severo Ochoa, evaluated the scientific merit of nineteen research proposals.

• The AIBS, under the sponsorship of the Office of Naval Research, conducted **a symposium on *The Molecular Structure and Functional Activity of Nerve Cells,*** at the Woodner Hotel, Washington, D.C., June 3-4, 1955. Speakers were: Vincent G. Dethier, Edward F. MacNichol, Jr., Roland Fischer, Martin Larabee, and Lorin J. Mullins. The Symposium was under the chairmanship of Ralph Gerard and discussion leaders were W. D. McElroy, Robert G. Grenell, and Philip W. Davies. The Proceedings will be published later in the year.

• For over two years AIBS has been preparing a major part of the biological section of the **National Register of Scientific and Technical Personnel.** The Register is now being put to use in Civil Defense. Statistics have been drawn for the numbers and kinds of biologists in key city areas as well as campus areas. Register personnel stood by with data during the maneuvers of a mock attack, Operations Alert 1955, which evacuated a percentage of Washington, D.C., June 15-17.

• **A Special Meeting of the AIBS Governing Board was held in Washington, April 23, 1955.** Dr. Bentley Glass, Chairman, reported on the separation of AIBS from the National Research Council, effected January 19, 1955, with the granting of incorporation in the District of Columbia. AIBS offices were moved March 17 to new quarters at 2000 P St., N.W. Dr. Hiden Cox accepted appointment as Executive Director, beginning July 1, 1955. In the interim period, Dr. Glass and Dr. Raymund Zwemer, Secretary-Treasurer, have been directing the activities of the Institute.

The Office of Naval Research Advisory Committees grant was retained by AIBS, as was the National Science Foundation grant covering the work on the National Register. Two new grants have been received from N.S.F. One was an organizational grant to assist in establishing AIBS on an independent basis and meet the additional costs of the fiscal year 1955. To meet a possible budget discrepancy in 1956, more income from societies was deemed necessary and the Board voted to abandon the assessment of 50¢ dues for members who belong to more than one Member Society. All societies will now be assessed $1.00 per member per year up to $1000. The removal of the $1000 limit was left to the voluntary action of each society.

Two organizations were accepted for Affiliate membership: The National Pest Control Association and The Biological Photographic Association.

The AIBS agreed to sponsor a *Committee for Basic Biological Research in Aging* and approved the formation of a *Committee on Biological Education and Professional Recruitment.*

The Chairman announced the appointment of a Nominating Committee that will bring in a slate of officers at the September meeting of the Governing Board, and a Constitution Committee, that will present a revised constitution at that time. Sunday, September 4 was chosen for the regular annual meeting of the Board, at East Lansing, Michigan. All future annual meetings will be held at the time of the September conventions.

The Biology Library

One copy of each publication submitted for listing should be sent to the Editor, The AIBS Bulletin, 2101 Constitution Avenue, Washington, D. C. Only books published within a year of receipt will be reviewed.

ANIMAL SCIENCES

Population Genetics. C. C. LI. 366 pgs. University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill. (1955) $10.00.

Dr. Li has produced an excellent basic text in this important field of genetics. A background of college algebra and rudimentary statistics will prepare the student for the subject. The scope of the book is limited to the classical Mendelian aspects of the field—biometrical genetics is not included. Fundamental principles and theorems, not experimental results, form the subject core. The notes and exercises at the conclusion of each chapter offer further examples and corollaries, alternative methods of solution and additional mathematical details.

Breeding Beef Cattle for Unfavorable Environments. Edited by ALBERT O. RHOAD. 248 pgs., 22 illus. University of Texas Press, Austin 12, Texas. (1955) $4.75.

To celebrate the 100th Anniversary of the King Ranch of Texas, an international gathering of scientists and cattle breeders assembled for a special Centennial Conference. This volume carries the discussions of the symposium. The Conference brought together practical ranchers, specialists in the various research fields which undergird progressive livestock operations, geneticists, nutritionists, botanists, veterinary scientists, and climatologists. Since the problems of intense heat and an arid range are common in many parts of the world, the exchange of information was internationally profitable.

West Highland Survey. An Essay in Human Ecology. Edited by F. FRASER DARLING. 438 pgs., illus. Oxford University Press, 114 Fifth Ave., New York 11, N. Y. (1955) $4.80.

In this survey of the sick but surviving culture of Highland Gaeldom, Dr. Darling examined the history and physical and biological characteristics of the Highland area and studied the ecology of land use, the rise and decline of populations, the agricultural background and the social conditions. The interactions of human behavior, ideas and practices, the growth and decline of populations and their consequences on the terrain and the present generation are the substance of this report. His aim was to find the causes of existing conditions and thereafter to suggest how the crofter's resources could be rehabilitated and more fully used.

The Biology of the Amphibia. G. KINGSLEY NOBLE. 577 pgs., 174 illus. Dover Publications, 1780 Broadway, New York 19, N. Y. (1954) $4.95.

This is an unabridged reissue of a well-known work in the field of herpetology. A biographical sketch of the author, who was the late Curator of Herpetology and Experimental Biology at the American Museum of Natural History, has been added in this reprinting. Since the content has not been changed, all who made good use of the book in the past will be able to recommend it again.

Zoology. A. M. WINCHESTER and H. B. LOVELL. 582 pgs., illus. D. Van Nostrand Co., 250 Fourth Ave., New York 3, N. Y. (2nd edition, 1955) $6.25.

A course based on this text would be a beginning one at the freshman level. The book would also be valuable for an

introductory biology course if used concurrently with a botany text. The second edition includes revisions, new chapters and additions to the sections on genetics and ecology. The general plan remains the same. The senior author teaches at Stetson University and the junior author at the University of Louisville.

The Human Machine. CHARLES W. SHILLING. 292 pgs., 156 figs. U. S. Naval Institute, Annapolis, Maryland. (1955) $5.00.

Capt. Shilling has prepared a most attractive and well-written biology book for nonmedical military personnel. The structure, function and hygiene of the human body forms the basic subject matter but considerable space has been allotted to group hygiene, preventative medicine, and sanitation, all subjects of considerable importance to military organizations. Chapters on Marine Biology, Underwater Activity, Aviation Medicine, and Twentieth Century Warfare stress special problems in new areas of biological research. Illustrations are humorous and effective.

The Ornithology of the Yucatan Peninsula. RAYMOND A. PAYNTER, JR. 347 pgs. Bulletin No. 9, Peabody Museum of Natural History, Yale University, New Haven, Conn. (1955).

The Yucatan Peninsula of Mexico has been an attractive collecting region for ornithologists since early in the 19th century. Although several hundred species have been collected and many new races discovered, no comprehensive ornithogeographic survey of the entire Peninsula had been made until the author conducted one from 1948-51. His monograph records the results and forms an invaluable reference for zoologists who intend to work in this region.

Life Science. THOMAS S. HALL and FLORENCE MOOG. 502 pgs., 487 illus. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. (1955) $6.50.

Drs. Hall and Moog have produced a splendid and pioneering book in general biology. Not only do the contents read in a flowing, absorbing way but the illustrations alone are worth considerable attention. The smell of a dissecting tray does not pervade—rather, natural history, so long neglected, makes an adventure story out of biological facts. The *activity* of science is stressed, experimental evidence given, the current emphasis on physiology rather than anatomy recognized, and human implications not exaggerated.

The Prevalence of People. MARSTON BATES. 283 pgs. Charles Scribner's Sons, 597 Fifth Avenue, New York 17, N. Y. (1955) $3.95.

Those who have read Marston Bates' *Where Winter Never Comes* will be particularly interested in the publication of this new book. The subject matter was gathered during a study made for the Rockefeller Foundation. Much of the material is 'delicate' to handle but Dr. Bates discussed taboos and areas of thought closed by custom in an intrepid manner. At all times a finely balanced sense of humor lightens the broad scientific considerations that this subject poses.

PLANT SCIENCES

The Botany of Cook's Voyages. ELMER D. MERRILL. 384 pgs., illus. Chronica Botanica Co., Waltham, Mass. (1955) $4.75.

Present day widely-accepted theories of the trans-Pacific transmission of plants, animals and peoples, are vigorously criticized by Dr. Merrill in this interesting book. From unpublished manuscripts of Solander, who accompanied Cook on his 1st voyage, and a comparison with the findings of the two Forsters, made on the 2nd voyage, only one food plant of American origin and possibly three weeds, existed in the Society Islands. All other species, cultivated or weeds, as well as the domestic animals, are shown to have been introduced into the Pacific Islands by invading people from Malaysia. This new botanical data will be of considerable interest to anthropologists, ethnologists, and many geneticists, as well as scientific historians.

Methods of Plant Breeding. H. K. HAYES, F. R. IMMER and D. C. SMITH. 551 pgs., 103 tables and figures. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y. (2nd edition, 1955) $8.50.

Additions to this revised second edition include a discussion of the centers of origin of crop plants, a more adequate discussion of heterosis, a summary of the current status of breeding for insect resistance, the breeding of cotton and sorghum as representative of crop plants often cross-pollinated, breeding studies with other cross-pollinated crop plants including sugar cane, and a review of the present viewpoint of breeding forage crops, including both legumes and grasses. The essential nature of the book, with the emphasis on methodology, has not been altered.

Photosynthesis. ROBERT HILL and C. P. WHITTINGHAM. 165 pgs. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. (1955).

Both authors of this contribution to the Methuen series on Biochemical Subjects, teach at Cambridge University, England. In slightly over 100 pages they summarize the biochemistry and physiology of photosynthesis in a concise, readable, introductory fashion.

Embryogenesis in Plants. C. W. WARDLAW. 381 pgs., illus. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. (1955) $7.00.

Until recently research in the embryology of plants followed the traditional methods of the anatomist and histologist. With new techniques and ideas, often borrowed from other fields, research has taken a new and interesting turn and the results are suggesting further fascinating work. This book is the first comprehensive survey of the field and covers all classes of plants, from Algae to Angiospermae. Embryological developments are discussed in terms of genetical and physical aspects and the bearing of embryological evidence on evolutionary and phyletic theory is also fully considered.

Origin and Distribution of the British Flora. J. R. MATHEWS. 173 pgs. Longmans, Green and Co., 55 Fifth Ave., New York 3, N. Y. (1955) $2.40.

Although the flora of Britain is one of the best-described in the world, little of it is endemic. The origin and geographic relationships of the native British flora is the subject of this small volume. The origin involves an examination not only of present-day distribution but also of occurrences in prehistoric times. The author is Emeritus Professor of Zoology at the University of London.

Plant Physiology. W. O. JAMES. 303 pgs., illus. Oxford University Press, 114 Fifth Ave., New York 11, N. Y. (5th edition, 1955) $2.80.

This book was originally written for senior school or junior university students (in England) and presents an account of the more elementary aspects of plant physiology. The fifth edition, prepared after a ten year lapse, has been extensively rewritten and rearranged.

MISCELLANEOUS

Methods of Biochemical Analysis. Vol. II. Edited by DAVID GLICK. 470 pgs., illus. Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. (1955) $9.50.

The 2nd Volume of this outstanding series includes: Analysis of Steroids by Infrared Spectrometry, Chemical Determination of Adrenaline and Noradrenaline in Body Fluids and Tissues, Lipide Analysis, Measurements of Lipoxidase Activity, Assay of Compounds with Folic Acid Activity, Determination of Vitamin E, Methods for Determination of Coenzyme A, Assay of Proteolytic Enzymes, Determination of Gluthathione, Determination of Serum Glycoproteins, New Color Reactions for the Determination of Sugars in Polysaccarides, Recent Developments in Techniques for Terminal and Sequence Studies in Peptides and Proteins, and Spectrophotometric Assay of Cytochrome c Oxidase.

Electrochemistry in Biology and Medicine. Edited by THEODORE SHEDLOVSKY. 369 pgs., illus. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. (1955) $10.50.

This book grew out of the Symposium on Electrochemistry in Biology and Medicine held in New York during the 103rd Meeting of the Electrochemical Society, April 1953. The contributing authors are all active in research in their fields and most discuss the particular work in which they are engaged. Subjects include membranes, nerve and plant cells, biologically important ions, applications of polarography, electrocardiography, and electroencephalography in medicine.

Vitamins in Theory and Practice. LESLIE J. HARRIS. 366 pgs., 103 fig., 107 tables. Cambridge University Press, 32 East 57th St., New York 22, N. Y. (4th edition, 1955) $6.50.

This is a fine example of the down-to-earth presentation of scientific subjects that British scientists so often offer laymen. Dr. Harris presents a completely up-to-date account of vitamins in a fashion that would do credit to a fiction writer. The "science" retains accuracy and detail—the illustrations are lavish and appropriate. This combination guarantees a wide audience for the book.

The Thyroid. Brookhaven Symposia in Biology No. 7. 271 pgs., illus. Available from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C. (1955) $1.75 (paper bound).

The Thyroid was the subject of the 7th Annual Symposium of the Biology Department of Brookhaven National Laboratory, held in June 1954. The subject followed, to some extent, the 1948 Symposium on Radioiodine. Fifteen papers appear in this volume. A wide range of basic and clinical research is reported and new hypotheses and concepts of thyroid physiology are presented.

Biological Specificity and Growth. Edited by E. G. BUTLER. 233 pgs. Princeton University Press, Princeton, N. J. (1955) $5.00.

Annually the Society for the Study of Development and Growth conducts a symposium. In 1953 the subject chosen for the 12th Growth Symposium was *Biological Specificity and Growth*. In developmental physiology the phenomenon of specificity occupies a prominent position. The papers of a dozen biologists who discussed this subject during the symposium, have now been published by Princeton University Press. Chemists, physicists and medical men, as well as biologists, should find the reported research results interesting.

Introduction to the Pathogenic Anaerobes. LOUIS DS. SMITH. 248 pgs. The University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill. (1955) $7.50.

This handbook is an important step in the right direction. For here, in one book, is much of the information—occurrence, morphology, cultural characteristics, isolation techniques and toxin produced—a bacteriologist wants and needs concerning the pathogenic anaerobes. However, the author states, "This book is intended to serve as a text to supplement lectures and is not intended to serve as a definitive study of the pathogenic anaerobes."

The Lipids. Their Chemistry and Biochemistry. Vol. II. Biochemistry. HARRY J. DEUEL, JR., 919 pgs. Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. (1955) $25.00.

The 2nd volume in this series on lipids had been planned to encompass the biochemical aspects but the recent great increase in new findings necessitated a division into two separate volumes. The present edition carries the available information on the digestion, absorption, transport (in blood and lymph), and storage of fats and other lipids in the animal body. Vol. III will include biosynthesis, metabolism, oxidation, and the nutritional value of lipids. An attempt has been made to list all investigators who have contributed to any study. When completed, *The Lipids* should be the definitive work in the field.

A History of Technology. Vol. I. From Early Times to Fall of Ancient Empires. Edited by CHARLES SINGER, E. J. HOLMYARD and A. R. HALL. 827 pgs., 570 fig., 36 pl. Oxford University Press, 114 Fifth Ave., New York 11, N. Y. (1954) $25.35.

Both the size and content of this book are tremendous. The contents are well worth hours of the scarce time of an active biologist. This is the first in a five volume series that tells the fascinating story of technological development in unadorned language with few specialist terms. Nearly all of the hundreds of illustrations have been specially prepared for the series. The senior editor is one of the world's outstanding historians of science and he has gathered together a notable panel of authors.

Management of Addictions. Edited by EDWARD PODOLSKY. 413 pgs. Philosophical Library, 15 East 40th St., New York 16, N. Y. (1955) $7.50.

Addiction to alcohol and various drugs are discussed by 48 leading authorities. The mechanisms of addiction are thoroughly explored and the most modern methods of therapy are given in detail. Physicians will find the contents most useful but many of the facts and theories will prove of interest to scientists generally.

Scientific Writing. META R. EMBERGER and MARIAN R. HALL. 468 pgs. Harcourt, Brace and Co., 383 Madison Ave., New York 17, N. Y. (1955).

Scientific Writing is concerned with the problems faced by scientists, technologists, and industrialists in communicating their findings. It is applicable to the general field of articles and reviews as well as the specialized area of technical reporting. It can, therefore, be used as a text or as a reference book. The authors are to be congratulated for bringing together such a wealth of helpful suggestions and examples.

Advances in Enzymology. Vol. XVI. Edited by F. F. NORD. 584 pgs. Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. (1955) $11.00.

Subjects and authors of this 16th volume of *Advances in Enzymology* are: The Structure of Coenzyme, A. J. Baddiley; Coagulation of the Blood, W. H. Seegers; Comparative Biochemistry of the Phenolase Complex, H. S. Mason; Transamination, A. Meister; Intermediates in Amino Acid Biosynthesis, B. D. Davis; Structural and Functional Aspects of Myosin, A. G. Szent-Györgyi; Beta-Glucoronidase, W. H. Fishman; and The Chemistry of the Cell Nucleus, B. G. Allfrey, A. E. Mirsky, and H. Stern.

College Physiology. DONALD M. PACE and B. W. McCASHLAND. 615 pgs., 315 fig. Thomas Y. Crowell Co., 432 Fourth Ave., New York 16, N. Y. (1955) $5.50.

College Physiology is an introductory text for both students who intend to continue in zoology and those whose chief concern is a survey of the function of the human body. It is written simply, with a minimum of biological knowledge assumed, and with all new terms fully defined. Illustrations, mostly new, are adequate and meaningful.

The Nitrogen Metabolism of Micro-organisms. B. A. FRY. 166 pgs. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. (1955).

This small volume, one of the Methuen Monographs on Biochemical Subjects, is based on a series of lectures delivered by the author to post-graduate students at the University of Sheffield. The survey reflects the current trends in modern microbiology, particularly in the area of nitrogen metabolism.

General Microbiology. WILLIAM G. WALTER and RICHARD H. McBEE. 345 pgs. D. Van Nostrand Co., 250 Fifth Ave., New York, N. Y. (1955) $4.75.

This is an excellent introductory text for microbiology, written in a clear, readable style. The book covers the broad scope of microbiology, from a short history of the subject to the complicated field of viruses and rickettsiae.

Mechanisms of Microbial Pathogenicity. Edited by J. W. HOWIE and A. J. O'HEA. 333 pgs. Cambridge University Press, 32 East 57th St., New York, N. Y. (1955) $5.00.

This book contains the papers delivered at the Fifth Symposium of the Society for General Microbiology in London, April 1955. The presentations are concerned with the bacteria, protozoa and fungi pathogenic to man, animals, and plants. The various papers are comprehensive reviews of the research in the field of pathogenicity up to the present time and provide most instructive reading.

Canadian Cancer Conference. Vol. I. Edited by R. W. BEGG. 443 pgs., illus. Academic Press Inc., 125 East 23rd St., New York 10, N. Y. (1955) $8.80.

The National Cancer Institute of Canada was founded in 1947 to aid the stimulation and financial support of fundamental cancer research. The First Canadian Cancer Conference, held June 1954, was planned to bring together the widely-scattered (geographically) recipients of cancer research grants and research fellows working with them. Guest American participants were also present. The Conference was planned to be educational as well as informative and both short research papers and major reports are included.

Rutin and Related Flavonoids. J. Q. GRIFFITH, JR., C. F. KREWSON, and J. NAGHSKI. 275 pgs., illus. Mack Publishing Co., Easton, Pa. (1955) $7.50.

In 1943 it was reported that rutin, a flavonol glycoside obtained from plants, was active in restoring capillary fault associated with hypertension. The authors of this book were concerned with this early work and have carried on clinical studies since. They present an evaluation of their research; a review of the work of others, both clinical and pharmaceutical; information on the chemistry and production of rutin; and a discussion of the initial clinical studies on quercetin.

Radiobiology Symposium, 1954. Edited by Z. M. BACQ and PETER ALEXANDER. 362 pgs., illus. Academic Press Inc., 125 East 23rd St., New York 10, N. Y. (1955) $9.80.

The need for informal symposia in subjects that cut across fields of science is being met more adequately today. Workers from different fields and disciplines engaged in studying the effects of ionizing radiation, from twelve different countries, met at Liege in August-September 1954. Most of the reports were of original research although a few review papers were included. This volume contains the papers presented and the discussions that followed each.

The Unleashing of Evolutionary Thought. OSCAR RIDDLE. 114 pgs. Vantage Press, 120 West 31st St., New York 1, N. Y. (1955) $4.50.

Dr. Riddle raises the question of whether reactionary religious influence is blocking social progress by barring evolutionary thought from this generation. The diverse adversaries of modern thought are named, the areas of conflict discussed, and the influence of organized religions upon education, news dissemination, and government reported in documented form. The subject is highly controversial and it is treated in a most forthright manner by the author.

A Practical Manual of Medical and Biological Staining Techniques. EDWARD GURR. 320 pgs. Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. (1953) Printed in Great Britain. $4.00.

The Life of Bacteria. KENNETH THIMANN, 775 pgs. The Macmillan Co., 60 Fifth Ave., New York, N. Y. (1955) $13.50.

The structure and activities of the bacteria and their influence on the surrounding world is the theme of this book. Although the material is aimed at the advanced student of bacteriology, the undergraduate will find it well written, and easy to read.

The Medical Significance of Anxiety. RICHARD L. JENKINS. 46 pgs. The Biological Sciences Foundation, Ltd., 1011 New Hampshire Ave., N.W., Washington 7, D. C. (1955) $1.00.

In the short space of 46 pages, the pertinent subject of anxiety is ably treated by Dr. Jenkins. The physical manifestations of anxiety, many of the modern underlying causes, and the current medical methods of control are discussed in a most readable style. Dr. Jenkins is Chief, Psychiatric Research, Psychiatry and Neurology Service of the Veterans Administration.

Tea. A Symposium on the Pharmacology and the Physiologic and Psychologic Effects of Tea. Edited by HENRY J. KLAUNBERG. 64 pgs. The Biological Sciences Foundation, Ltd., 1011 New Hampshire Ave., N.W., Washington 7, D. C. (1955) $1.00.

The papers included in this conference, held at the N. Y. Academy of Science, May 1955, were selected to initiate a collection of research and clinical data on tea that would prove helpful to dietitions, nutritionists, the medical profession and those engaged in research. Since tea is the second most popular beverage in the world, the subject matter should prove interesting to laymen as well as scientists.

LABORATORY MANUALS

Laboratory Plant Physiology. B. S. MEYER, DONALD B. ANDERSON and C. A. SWANSON. 168 pgs., D. Van Nostrand Co., 250 Fourth Ave., New York 3, N. Y. (3rd edition, 1955) $3.50.

CORRECTION.

Mosquito Culture Techniques, by H. L. TREMBLEY reviewed in the April 1955 *A.I.B.S. Bulletin*, was said to be avaliable upon request. This should be corrected to read; Cost $2.00.

Private Bibliographies

Addendum

BRAINS OF EXTINCT VERTEBRATES. Tilly Edinger. Museum of Comparative Zoology, Harvard College, Cambridge 38, Mass. Period: 1804 to date. Approx. 700 references. Annotated. May be seen.

FOSSIL RODENTS AND LAGOMORPHS. GROSS ANATOMY OF RODENTS AND LAGOMORPHS. Albert E. Wood, Biology Department, Amherst College, Amherst, Mass. Period: to date. Approx. 6000 references. Inclusive. Not geographically limited. Partially annotated. May be seen.

SCOMBROID FISHES. Donald de Sylva. University of Miami Marine Laboratory, Coral Gables 34, Fla. Period: to date. Approx. 750 references. Partially annotated. May be seen.

All members of Member Societies of AIBS that plan to meet at East Lansing will receive their General Programs **in the mail** during August. **All others** will receive their Programs at the Registration Desk. **Extra copies will cost $1.00.**

Comparisons Between Biologists and Other Professional Groups

DAEL WOLFLE

American Association for the Advancement of Science

THE Commission on Human Resources and Advanced Training, in the course of the work which led to its report *America's Resources of Specialized Talent* (2), studied the major scientific and professional groups in the United States. In this article, comparisons will be given between biologists and their colleagues in other areas. Similar comparisons between psychologists and other professional groups have also been published (5).

Number of Biologists in the U. S.

Anyone interested in manpower statistics has his choice among several answers to the question *How many biologists are there in the United States?* For instance, the 1950 census tabulation listed 18,547; the Commission estimated that there were 52,000 in 1953. The discrepancy between these figures results from differences of definition and difficulty of counting. Biology spreads gradually into other fields of science and into the applied areas which are based upon the biological sciences.

The Commission's estimate of 52,000 was based upon a liberal definition, one comparable to the definitions of engineers, lawyers, pharmacists, or chemists, namely, employment in a type of work in which most persons doing similar work have completed a bachelor's or first professional degree with a major in the corresponding field of study. Some engineers have bachelor's and some have higher degrees in engineering; some graduated from college with majors in mathematics, physics, geology, or something else; and some did not graduate from college at all. The majority, however, are graduates of engineering curricula, and both they and the others who are doing comparable work are called engineers.

Our definition of a biologist was strictly comparable to this definition of an engineer. It included all persons employed in those types of work in which the majority of workers hold a bachelor's or higher degree with a major in biology. Excluded, however, were persons classed in agriculture, home economics, and the health fields. The 52,000 biologists include persons with diverse educational backgrounds and include some who do not have the word *biologist* in their job titles.

From the standpoint of maintaining high standards, there are obvious objections to this liberal definition. But it has the virtue of paralleling minimum definitions in other fields, and so makes comparisons more meaningful. On this basis it is possible to say that biologists are roughly two-thirds as numerous as chemists and somewhat more numerous than social scientists or earth scientists. On the same basis it is possible to compare the 52,000 biologists with estimates of 205,000 in agriculture, 41,000 in home economics, 185,000 in medicine, 84,000 in dentistry, 340,000 in nursing, and 126,000 in other health fields. None of these figures agrees exactly with census counts, but all were arrived at in the same way and thus serve to indicate comparative sizes of the different fields.

The work here reported was carried out between 1950 and 1954 while I was director of the Commission on Human Resources and Advanced Training. I am indebted to Drs. Toby Oxtoby and Joseph Smith, both now of the Rand Corporation, who were members of the Commission staff. D. W.

Comparative Growth of Biology and Other Fields

Table 1 shows the relations between the estimated numbers of people earning bachelor's and doctor's degrees in biology and the numbers earning those degrees in all fields combined. Early in the century, about one college graduate in twenty to twenty-five had majored in biology. The proportion was slightly smaller during some of the intervening years, but in the last ten years has again risen to the beginning-of-the-century ratio. All told, about 255,000 biology majors graduated from American colleges between 1901 and 1953. About 234,000 were still living in 1953.

TABLE 1.

DEGREE TRENDS IN BIOLOGY AND IN ALL FIELDS COMBINED

Years	Bachelor's and First Professional Degrees			Doctor's Degrees		
	Total Conferred	Number in Biology	Per Cent in Biology	Total Conferred	Number in Biology	Per Cent in Biology
1901-1905	149,500	7,200	4.8			
1906-1910	173,300	7,400	4.3			
1911-1915	206,000	7,900	3.8	2,460	350	14.2
1916-1920	216,700	7,500	3.5	2,770	390	14.2
1921-1925	360,200	12,500	3.5	4,710	680	14.4
1926-1930	550,700	21,800	4.0	8,740	1,280	14.6
1931-1935	684,800	24,100	3.5	13,420	2,130	15.9
1936-1940	824,700	28,800	3.5	14,900	2,810	18.9
1941-1945	779,900	28,900	3.7	14,490	2,710	18.6
1946-1950	1,412,200	63,300	4.5	21,060	2,470	11.7
1951-1953	1,021,100	45,400	4.5	21,330	2,680	11.5
Total	6,379,000	255,000	4.0	105,900	15,500	14.6
Total living	5,855,000	234,000	4.0	96,600	14,100	14.6

Table 2 shows similar figures for bachelor's and first professional degrees (M.D., D.D.S., etc.) in agriculture, home economics, and the health fields. Although neither agriculture nor home economics now accounts for more than 3 per cent of current graduates, in percentage terms both have grown enormously during the past half century. The health fields have shown the opposite trend. Despite the increases in numbers of nurses and pharmacists with college degrees, the over-all percentage has dropped greatly. Medicine, almost the oldest profession, early became established as a field for college graduates. Figures collected by Burritt (1) indicated that between 1800 and 1900 some 28 per cent of all college graduates entered medicine. With the great growth of total college enrollment in more recent decades, the number of medical students, although not decreasing numerically, has gradually come to represent a smaller and smaller fraction of the total. Much the same thing has happened in dentistry.

TABLE 2.

DEGREE TRENDS IN THE FIELDS OF APPLIED BIOLOGY

Years	Bachelor's and First Professional Degrees					
	Agriculture		Home Economics		Health Fields	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
1901-1905	400	0.2			49,600	33.2
1906-1910	700	0.4			48,400	27.9
1911-1915	3,400	1.7	700	0.3	47,900	23.2
1916-1920	10,700	4.9	3,800	1.8	35,100	16.1
1921-1925	12,000	3.3	6,400	1.8	43,400	12.1
1926-1930	11,000	2.0	10,300	1.9	52,500	9.5
1931-1935	13,000	1.9	15,500	2.3	48,100	7.0
1936-1940	23,300	2.8	23,100	2.8	50,100	6.1
1941-1945	17,300	2.2	33,600	4.3	57,800	7.4
1946-1950	38,000	2.7	36,800	2.6	83,900	5.9
1951-1953	30,600	3.0	23,100	2.3	61,100	6.0
Total	160,000	2.5	153,000	2.4	578,000	9.1
Total living	150,000	2.6	147,000	2.5	481,000	8.2

At the Ph.D. level, the percentage of students who specialized in biology rose from around 14 per cent in 1911-1920 to above 18 per cent in 1936-1945 (Table 1). In the years since World War II, other fields of study have drawn larger numbers of Ph.D. candidates, and the biology portion has dropped to between 11 and 12 per cent. In the total living population of persons with Ph.D. degrees in the U. S., about one in seven specialized in biology.

Looking back over past years, members of most of the specialized fields can see evidence of very substantial growth. Biology has expanded rapidly, but biology is not alone in that regard. Figure 1 shows the increases in the number of Ph.D. degrees awarded in several fields from 1911 through 1953.

It is always of interest to try to estimate the number of future degrees to be conferred in a field. If recent percentage distributions continue relatively unchanged for the next few years, from 1956 to 1960 graduating classes will include, on the average, about 13,500 biology majors. During the same period, an average of approximately 800 Ph.D.'s in biology per year can be expected. (See references 2 and 4 for methods and data for these projections.)

TABLE 3

OCCUPATION IN 1952 OF PERSONS WHO GRADUATED FROM COLLEGE IN 1951 WITH MAJORS IN BIOLOGY*

	A.B. in Biology in 1951		M.A. in Biology in 1951	
	Men	Women	Men	Women
Education-related employment	30%	62%	47%	65%
Nonrelated employment	4%	1%	**	0%
Full-time students	48%	21%	42%	16%
Military duty	15%	1%	7%	0%
Unemployed	2%	5%	1%	1%
Housewives	0%	10%	0%	16%
Other	1%	1%	2%	0%
Total number in sample	1540	507	348	80
Type of position of those in educationally-related employment				
Chemistry	12%	6%	3%	10%
Biology	22%	29%	57%	50%
Other sciences	1%			
Engineering	4%			
Agriculture	3%		3%	
Health fields	9%	23%	4%	11%
School teaching	23%	26%	20%	20%
Business and commerce	26%	11%	10%	4%
All other fields	1%	5%	3%	6%
Total number in sample	469	315	162	53

* Questionnaires were mailed to 20 per cent of the students who received bachelor's degrees and to 33.3 per cent of those who received master's degrees in June, 1951. Among the respondents, the students who had majored in biology were distributed as shown in the table (3).
** Less than 0.5 per cent.

Occupational Distribution in 1952 of Undergraduate Majors of 1951

The National Science Foundation in 1952 conducted a follow-up study of a sample of persons who obtained bachelor's or master's degrees from American colleges in June 1951 (3). What the 1951 graduates in biology were doing in 1952 is shown in Table 3.

At the bachelor's degree level there were large sex differences. Nearly half of the men were continuing their training in graduate or professional schools, and 15 per cent were in military service. Nearly all of the rest were employed in fields related to their educational backgrounds, but a few were in nonrelated work and a few were unemployed. Among the women graduates, nearly two-thirds were employed in jobs related to their training; about a fifth were in graduate or professional schools; and a tenth had left the labor force because of marriage.

The category "education-related employment" included many occupations outside of pure biology; the intent was to include all jobs in which there was a reasonable amount of demand for what the student had learned as an undergraduate biology major. A breakdown of this category is given in Table 3.

At the master's degree level, there was also a spreading out into other fields, but the diversity was less marked than at the A.B. level; over half were employed in clearly biological jobs, about a fifth were teaching school, usually at the secondary level, and some 10 per cent were in business.

That an undergraduate major is frequently taken as preparation for a career in something other than pure biology is well known. The fact was clear in an analysis (not shown in any of the tables) of the fields of study being pursued by those of the 1951 graduates who were still in school in 1952: 60 per cent were in professional schools in the health fields; 26 per cent were specializing in one of the natural sciences; 4 per cent were specializing in education; and the other 10 per cent were scattered among all other fields.

TABLE 4.

ESTIMATED OCCUPATIONAL DISTRIBUTION IN 1953 OF LIVING COLLEGE GRADUATES WITH MAJORS IN BIOLOGY

Occupational Field in 1953	All Living Graduates		Master's Degree Holders
	Men	Women	
Biology	16%	16%	45%
Other professions	49%	8%	15%
Elementary and secondary school teaching	6%	6%	11%
Business	3%	5%	2%
Administration	4%	5%	3%
Subprofessional work	3%	1%	4%
Full-time study	13%	5%	11%
Not in civilian labor force (including those in military service)	6%	54%	9%

Occupational Distribution of All Living Graduates

Table 4 shows the Commission's estimates of the occupational distribution in 1953 of all living college graduates who had majored in biology. Approximately 16 per cent of the men and 16 per cent of the women were biologists. Remembering, from Table 1, that an estimated 234,000 persons with bachelor's degrees in biology were living in 1953, it can easily be computed that these graduates account for over 37,000 of the estimated total of 52,000 biologists in the country. An additional 9,000 graduated from college with majors in other fields, some allied to biology and some not, and then entered biology through graduate work or through their jobs. An estimated 6,000 were not college graduates.

Just as people whose undergraduate work has been in other fields became biologists, so some—indeed the large majority—

of those who had majored in biology became something other than biologists. About half of the men and 8 per cent of the women were employed in other professions, chiefly medicine. About 6 per cent of both sexes were engaged in elmentary or secondary school teaching. Smaller percentages were in business, administrative work, or subprofessional jobs. Six per cent of the men and 54 per cent of the women were out of the labor force—the men chiefly because they were in military service; the women chiefly because they were married and not working outside their homes.

Table 4 also gives the estimated occupational distribution in 1953 of persons who had received master's degrees in biology, but the sample on which the estimates were based was not large enough to justify a breakdown by sex.

TABLE 5.

INTELLIGENCE TEST SCORES OF BIOLOGY STUDENTS IN COMPARISON WITH OTHER STUDENTS

	Percentile Scores Converted to Army General Classification Test Scale				
	10	25	50	75	90
All students receiving bachelor's degrees	107	114	121	128	135
Students receiving bachelor's degrees in biology	107	114	121	128	135
Students receiving bachelor's degrees in agriculture	109	114	119	125	132
Students receiving bachelor's degrees in home economics	95	105	113	119	125
All graduate students	109	116	124	132	139
Graduate students in biology	112	118	126	133	140
Graduate students in agriculture	116	122	127	133	139
Graduate students in home economics	105	111	116	122	125
Students receiving Ph.D. degrees in natural sciences	117	125	133	143	153
Students receiving Ph.D. degrees in biology	115	122	129	137	145
Medical school students	114	120	127	133	140

Intelligence Test Scores

Tests of academic aptitude are now so widely given to college entrants that it is possible to compare the score distributions of students who have specialized in different fields. Table 5 compares students who majored in biology and some of the fields of applied biology with all students at the same degree levels.

Students currently receiving bachelor's degrees in biology are an almost exact cross section of all students receiving A.B. degrees. Those majoring in agriculture tend to be slightly below the general average, and those in home economics, farther below. At the graduate student level, the data indicate a slight superiority of biology and agriculture majors to the general run of graduate students, but the home economics majors are again substantially below average in the scores they make on academic aptitude tests. The sample of students receiving Ph.D. degrees was too small to be taken without caution, but the figures indicate a moderately lower distribution of scores for biology majors than for the total group. Perhaps the best generalization of these figures is that students who major in biology and its applied areas, with the exception of home economics, constitute a fairly random sample of all students of the same level.

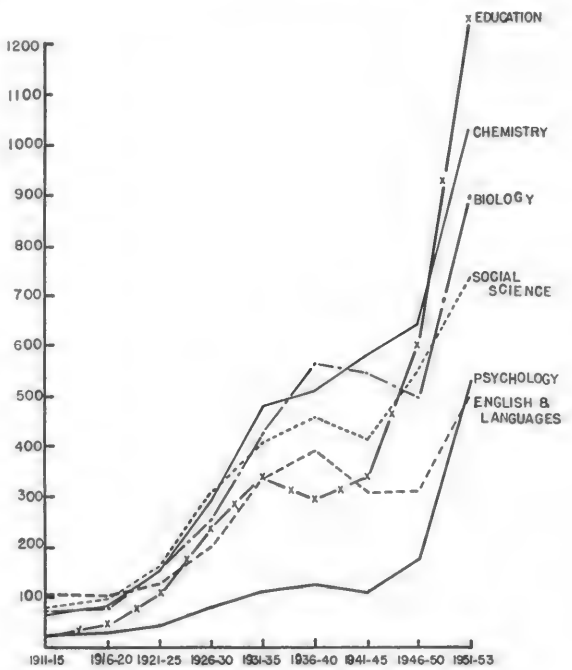
Summary

It is estimated that, as of 1953:

1. There were 52,000 persons working as biologists in the United States, and 981,000 working in one or another of the applied fields related to biology.

2. There were 234,000 living persons who had earned bachelor's degrees on the basis of a major in biology.

FIGURE 1. Average annual number of Ph.D. degrees conferred in selected fields



Vertical legend: Number of Ph.D. degrees
Horizontal legend: Years

3. There were over 14,000 living persons with Ph.D. degrees in biology.

4. The students who currently major in biology represent a good cross section—in terms of academic aptitude test scores—of all college students.

5. Students who majored in biology for their bachelor's degrees have scattered out into a wide variety of occupations. About three times as many of the men are in other professions, such as medicine, as are engaged in pure biology. For the women, the number in biology is double the number in other professions; others have gone into secondary school teaching, business, or other fields. Over half of the women graduates have left the labor force.

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The Demand for Biologists

HOWARD A. MEYERHOFF, *Scientific Manpower Commission*

SCIENTISTS enjoy, and even cultivate, the reputation of being rugged individualists, but one may reasonably wonder whether biologists may not have carried the trait too far. There are more biological organizations than in any other field of science, and there is less cohesion among them. A few insist on functioning in splendid isolation, and even those that have developed gregarious interests differentiate themselves rather sharply into three categories—general, medical, and agricultural.

Perhaps there is nothing drastically wrong in this situation, but it does explain why biologists as a group know less about themselves than other scientists do, and why it is difficult to assemble information about them. In time the new register of biological personnel will no doubt help, but for the present we must content ourselves with the Bureau of Labor Statistics analysis of the 1951 register, which has just been published by the National Science Foundation (*Manpower Resources in the Biological Sciences.* Superintendent of Documents, Washington 25, D. C., 40 cents).

Available Supply of Biological and Agricultural Scientists

The study made by the National Science Foundation, with the collaboration of the Bureau of Labor Statistics, is based upon individual returns that were received from 21,000 biologists, 40% of whom were in agricultural biology. An estimate of the total population of biologists is provided, but the figure—50,000—appears to be extraordinarily low, especially in view of the fact that approximately 17,000 bachelors' degrees are awarded annually in agriculture and biology. This number of graduates would replace the entire population of professional biologists within three years if every major made a career of his specialty. Obviously this is not happening, but even so it is difficult to believe that there is so much attrition among the many students who major in biology and agriculture as undergraduates. The NSF-BLS figures demand critical scrutiny, and it may be profitable to follow as many of the 17,000 graduates as available information will permit. Such a course may prove fruitful in enabling us to assess and to revise the NSF-BLS figure, and it should also provide us with a rather sensitive index to the demand for specialists in the allied disciplines of biology and agriculture.

Within these fields a comparatively large percentage pursues graduate study. Admittedly, the NSF-BLS study was more successful in reaching practicing scientists with advanced degrees than it was in reaching those with less education. Of the 21,000 who submitted usable returns, 40% had earned the doctor's degree and an additional 20% had masters' degrees. There was a wide range among the specialties—for example, three quarters of the respondents in genetics, plant science, and biophysics held doctors' degrees; 50% of the specialists in animal sciences, microbiology, and pharmacology were Ph.D.'s; only 25% of the agricultural scientists held the highest earned degree attainable. The figures provided by the Office of Education on degrees earned in 1954 show that, while 17,000 students were earning first degrees in agriculture and the biological sciences, 2900 more were taking masters' degrees, and nearly 1600 qualified for the Ph.D. Although it is evident that a substantial number of biology majors continue their education—at least as as many receive higher degrees in a single year—the proportion is only 30%—a figure considerably below the 60% of masters and doctors recorded in the NSF-BLS survey.

In 1954 the Scientific Manpower Commission undertook a study of the demand for scientists, and its analysis of the situation in industry is now complete. The Commission was apparently more successful in reaching biologists without graduate training, and its results indicate that, of all biologists professionally employed, only half have earned an M.S. or a Ph.D. If we accept the Scientific Manpower Commission's one-to-one ratio, we may draw the following conclusions: In 1954, 4500 students received graduate degrees and entered the profession. Of the 17,000 who graduated from college with majors in biology, roughly 4500 entered graduate training, replacing those who completed graduate work, and another 4500 went directly from college into biological occupations. In this way we can account for 9000 of the first-degree graduates with a reasonable degree of assurance.

It is much more difficult to determine what happened to the remaining 8000. An examination of the NSF-BLS returns reveals that only 105 were received from biology-trained teachers in the elementary and secondary schools. Yet biology is the most widely taught science in our high schools, and surely a substantial number of the teachers were majors in biology rather than in education. This conclusion is amply confirmed in a study prepared by the National Education Association's Research Division, published under the title "The 1955 Teacher Supply and Demand." The analysis, which was made under the direction of Ray C. Maul, shows that 1541 students with majors in agriculture qualified for high school teaching, although only 632 actually accepted teaching appointments in September 1954. For biology, 1343 majors qualified, but only 620 took teaching assignments. Apparently these 1252 people were ruled out of the NSF-BLS survey by definition, but they must be included as a significant element in the group of college majors we are following.

The NSF-BLS survey records 190 farmers, and here, too, it is clear that for understandable reasons the figure does not reflect the substantial number of agricultural majors who return to the farm and who cannot be classified as agricultural scientists. A guess, which neither the Department of Agriculture nor the Association of Land-Grant Colleges can substantiate or deny, is that 40% of the majors in agriculture, 20% in animal husbandry, and 10% in forestry, or a total of 2600, choose farming as a means of livelihood. This still leaves us with 1600 agricultural majors unaccounted for, and twice that many biologists. Of the latter, some migrate into the medical field, but, as Table 1 shows, nearly 4000 college graduates, upon receiving the bachelor's degree, make no further professional use of their training. That many women make this decision may be concluded from the fact that the percentage of women professionally employed is approximately 18% of the total, whereas women comprise 28% of the students earning first degrees.

TABLE 1

Supply of bachelors, 1954		17,000
Distribution		
Graduate study	4,500	
Professional employment	4,500	
Teaching	1,250	
Farming	2,600	
Medicine and miscellaneous	350	13,200
Lost to the profession		3,800

There is, of course, no implication that the attrition is bad in itself. On the contrary, it suggests that, among the sciences, biology performs a cultural function that is unmatched in other fields. Outside the sciences, the pursuit of a major is primarily a means of meeting an academic requirement, and the individual's choice may or may not have a vocational connotation. In an age of science and technology it would be helpful if a much higher proportion of college students took more science courses, though scientists have themselves to blame for the fact

that the ratio is so low. Where, outside some of the small liberal arts colleges, is any departmental encouragement given a student who wants science as a cultural major? Even our beginning courses are commonly taught as if all those who take them should be cast immediately in the mold of the professional researcher.

Employment in Agriculture and Biology

Table 2 shows the distribution of the 19,375 agricultural and biological scientists from whom usable replies were received in the NSF-BLS study. This survey, as has been noted, missed many first-degree graduates employed in industry and virtually ignored secondary school teachers, hence correction and adjustment of the percentages are in order.

TABLE 2

	Percentage	
	NSF	*Adjusted*
Educational Services	47.1	49.4
Government	32.5	26.0
Industry	12.4	18.0
Farms and Forestry	1.5	1.2
Miscellaneous	6.5	5.4
	100.0	100.0

In our high schools there are more than 14,000 biology teachers. Not all, however, majored in biology, but between biology and agriculture it is a conservative guess that 7000-7500 majored in their specialty as undergraduates, and these should be added to the employment figures. With respect to college and university teachers, the NSF-BLS study can be checked against the *Educational Directory* of the University of Chicago Press. Table 3 gives the academic population as recorded in this publication.

TABLE 3

Agriculture	5,795
General Biology	5,499
Medical Biology	12,945
Total	24,239

The total compares well with 23,250, computed from the NSF-BLS estimate of 46.5% college-university teachers in a total population of 50,000.

The computation of 16,575 government workers—11,220 in federal service and 5355 in state and local government work—seems reasonably reliable, but the 6324 that the NSF-BLS survey assigns to industrial employment is a serious underestimate. The Scientific Manpower Commission did not cover the agricultural field effectively in its Survey of Demand for Scientists in Industry, yet its tabulations, which are comprehensive only for general and medical biology, show that 7350 biologists are in commercial work. Its objective mass approach to the problem has yielded a more reliable statistical result than a method involving use of individual returns, which caught the Ph.D.'s but missed many of the first-degree and some of the second-degree biologists. This fact is brought out in the contrasting sets of figures obtained by NSF-BLS and by SMC on the distribution of scientists in industry by level of education, as shown in Table 4.

TABLE 4

	Percentage	
	NSF-BLS	*SMC*
Ph.D.	26	14.0
M.S.	22	16.5
B.S.	46	69.5
Other	6	

There is every reason to believe that the figures for Ph.D.'s are most nearly comparable in both studies, and that the SMC percentages of distribution are closer to the facts. Computations based on these two assumptions yield a total of 10,500 biologists employed in industry. If conservative allowances are made for SMC's limited coverage of agricultural scientists, the figure may be nearer 12,000. If these corrections and additions are taken into account, the NSF-BLS figures for biological employment must be revised (Table 5).

TABLE 5

Education	
College, University	24,240
Secondary	7,250±
Government	
Federal	11,220
State and local	5,355
Industry	11,500±
Miscellaneous	4,250±
Total	63,815

Industrial Demand for Biologists

In the Scientific Manpower Commission's study of demand for scientists in industry, education, and government, industry's needs were given priority. The summary of findings, released this spring, will be supplemented by a more detailed report that is scheduled for early publication. The material presented in this section is drawn from the detailed report.

Certain limitations were forced upon the Commission in seeking information from industrial concerns. The keeping of personnel records has only recently become general practice, hence it was agreed that educational training could be obtained for scientists who are now being hired but might be unavailable for older employees. The SMC questionnaire was designed accordingly. Similarly, it was assumed that few companies could supply information on specialties, and that it would be wise to restrict the classification of scientists to the broad disciplines. Even so, numerous questions of classification arose, and the Commission does not know how, in many instances, they were resolved. In biology, for example, most personnel directors listed agricultural scientists under "Other," but how many were thrown into this miscellaneous category cannot be determined. The figures given here, which include returns from 874 companies, thus provide comprehensive coverage for the general and medical biologists but uncertain coverage for agricultural biologists.

Biologists rank third among scientists in industrial employment, as Table 6 shows (SMC Table 1). Chemists lead the other professions by a wide margin, and earth scientists hold a slight

TABLE 6

Total Number of Scientists on Payroll December 31, 1953

*Scientific Field**	*Men*	*Women*	*Total†*	*Estimated Percentage of Coverage*
Biology	2,593	653	3,306	45
Chemistry	30,619	2,101	35,616	55
Geology	4,252	51	4,304	33
Mathematics	2,778	571	3,785	65
Physics	4,433	121	5,407	75
Psychology	832	84	920	70
Other (except Engineering)	4,835	308	5,332	—
Total	50,337	3,889	58,670	

* Field determined by company job classification.

† Totals include figures from returns in which sex of employee was not specified.

lead over the biologists. Women comprise 19.75% of the total—a far more plausible proportion than the 7.6% recorded in the NSF-BLS survey. On the assumption that the SMC computation covers 45% of the biological field except agriculture, there was an annual demand for approximately 1700 biologists. Approximately 1000 change jobs, resign, retire, or die during the year, but a comparatively small number—perhaps 350—leave the profession. Apparently, then, industry is absorbing about 1000 new biologists a year, 14% of them Ph.D.'s, 16.5% masters, and 69.5% bachelors. The rate of growth indicated is just under 10% for each of the two years covered, insofar as demand for new biological talent is concerned.

The SMC study further reveals that nearly two-thirds of the employment is in the chemicals industries, with drug research and manufacturing using nearly three times as many biologists as any other occupational field. Figures on employment, hiring, and separations in 1953 for the more important industries are worth examining (Table 7).

TABLE 7

Industry	Biologists on Payroll, 12-31-53	Biologists Hired, 1953	Separations 1953
Drug	1,247	220	136
Organic Chemicals	449	83	62
Other Chemicals	463	89	40
Food Products	427	107	96
Research and Other Services	291	87	60
Petroleum	92	36	7
Transportation	90	31	2
Agriculture and Forest Products	60	11	5
All Others	187	58	41
Totals, 871 companies	3,306	725	449

Industrial employment for biologists differs in one respect from that for other scientists—only 30% of them work in large organizations. The Commission's survey measured the size of companies by the numbers of scientists employed, and the returns disclose the fact that 40% of the chemists and mathematicians, 50% of the geologists, and 60% of the physicists work for companies that employ 500 or more scientists. How much meaning can be attached to this interesting sidelight is unknown.

Conclusion

A thoughtful analysis of the statistics that have been assembled in this article prompts several conclusions and an even greater number of collateral ideas. In numbers professionally employed, the biological profession is second only to chemistry (65,000 v. 85,000). Yet the number of degrees granted annually in biology far exceeds the number awarded in chemistry. In 1954, for example, the Office of Education gave the figures shown in Table 8.

If the men who forsake the agricultural profession for the farm are eliminated, there are currently 2500 more biologists

TABLE 8

	Agriculture	Biology	Chemistry
Bachelor	7,832	9,366	5,971
Master	1,302	1,610	1,098
Doctor	515	1,077	1,013
	9,649	12,053	7,902
		21,702	

entering the profession each year than there are new recruits in chemistry. The universities and colleges and the government are absorbing 75% of them—industry only 18%. For chemistry these figures are very nearly reversed. To anyone who analyzes the distribution of biologists in industry it must come as a shock to find four times as many chemists in the food industry as biologists; twice as many chemists in industries based on agricultural and forest products; two and one-half times as many chemists in the drug industry.

Industry's preoccupation with the applications of chemistry to biological products suggests that biologists can successfully enter this field in larger numbers if they will combine a greater amount of organic chemistry with their biological training. Here is a field in which there is a shortage, which is being filled unsatisfactorily by chemists who know too little biology and by biologists who know too little chemistry. The statistics also contain a hint that graduate biologists are oblivious of—or indifferent to—industrial opportunities, because eight times as many chemistry Ph.D.'s are entering industry as biology Ph.D.'s, and six times as many masters. The ratios stand in marked contrast to the comparative numbers of these degrees awarded.

All the facts that have been assembled in this paper do not, however, add up to a comprehensive picture of the profession as a whole. It is merely hoped that some of them will prove sufficiently provocative to stimulate additional and more definitive studies. Biologists still know too little about themselves.

Oceanography at the Chesapeake Bay Institute

DAYTON E. CARRITT, *Assistant Director*

THE Chesapeake Bay Institute was organized in 1949 as the Department of Oceanography of The Johns Hopkins University. In the five years since then, its development within the academic framework of "The Hopkins" and the establishment of a field laboratory with sea-going facilities on the Chesapeake Bay have given the staff and students of the Institute some unique opportunities for study and research.

The academic program in the Institute has been developed in a period during which the entire University program of undergraduate and graduate training has been reexamined and modified. Under the "Hopkins Plan," a graduate student in oceanography can be assured of adequate preparation in all of the basic science fields that contribute to the advancement of oceanography as well as guidance while developing proficiency in one of the specialized branches of the science. This combination of broad as well as specialized training is achieved by setting up individual programs of graduate study designed to each student's capabilities, previous preparation, and desires. The facilities of all the departments and institutes of the University are readily available to each student and joint programs between oceanography and chemistry, oceanography and biology, etc. are encouraged. Within the Institute, instruction is given in the various oceanographic specialty fields, and research facilities, both sea-going and land-bound are maintained. During the past five years, six masters degrees in oceanography have been granted and three students are now completing work for the Ph.D.

The staff of the Institute is also engaged in research studies on the Bay and its tributaries. In addition to physical and chemical programs that have been carried on, a program in aquatic ecology has recently been initiated. Emphasis here is on the organisms that form the base of the food pyramid—the phytoplankton and zooplankton.

The controlling philosophy behind these ecological studies is that when the behavior of a natural system is truly understood it will be possible to predict what the state of the system will be at some time in the future. Basically, ecology is the study of the interrelationships that exist between organisms and their environment. We interpret interrelationships here as events that are linked together as causes and effects. The primary effects we designate as the reproduction, growth and death of the organisms being studied. The causes we wish to discover are the biological, physical and chemical factors in the environment that accelerate or retard these functions of the organisms. We recognize that the system under study undoubtedly is composed of many multiple causes—single effect relationships in which dominant causes are continually changing. Despite the obvious complexity of such a system it seems possible now to isolate for study various groups of factors that we initially hypothesize as either being or not being causal factors and by appropriate measurement and analysis of the results attempt to disprove the hypothesis.

Lucas (1947) pointed out the kinds of relationships that might exist between two or more groups of organisms existing

either simultaneously or consecutively in an environment. The relationships he pictured are largely the effects of one group of organisms produced by metabolic processes of other organisms. Environmental changes are brought about by the utilization or liberation of substances during the metabolism of one group thus forming an environment that either favors or inhibits the functions of another group of organisms. There is a growing body of literature giving the results of *in vitro* nutritional studies that emphasize the auxotrophic character of many fresh water and marine phytoplankton. Our inability to grow many common organisms in pure culture and in completely defined media suggests that the need for growth factors may be more prevalent than commonly supposed.

The ecological studies being carried on by the Institute are designed to take advantage of the results from these *in vitro* nutritional measurements. The seasonal and geographic distributions of phytoplankton and zooplankton in the Bay are being measured together with the distributions of a group of trace metals that have been shown to be important in nutrition. Of the many organic substances (metabolic wastes and decomposition products) known to act as growth factors, only vitamin B_{12} can be determined in natural waters in what amounts to a semi-routine manner. As analytical methods for the determination of other compounds become available, they will be added to the program. Measurements of the kind outlined above are carried on in addition to the more or less routine field observations of temperature and salinity, and the field observations for the ecological studies and those made in support of the Institute's already well developed circulation studies are carried out at the same time.

The Institute has taken part in several cooperative programs with the state and federal fisheries laboratories that work in the Chesapeake Bay. The first of these was a joint program between the Institute, the Virginia Fisheries Laboratory, and The Shellfisheries Investigation Laboratory of The U.S. Fish and Wildlife Service. The study was of the oyster seed-bed area of the James River, one of the most productive regions in the world so far as seed oysters are concerned. The Institute's contribution was a study of the circulation of the region. The results emphasize the importance of this physical feature of the environment in investigations of this kind, especially when the organisms being studied are free floating, as are oyster larvae. It was shown that the circulation in the lower James River involves a net upsteam flow in the lower depths of the estuary of a magnitude sufficient (15 to 20 miles in two weeks) to carry the larvae from the brood-stock region to the region where set occurs.

Commercial crab fishermen have noted that frequently the crabs taken in crab-pots in restricted regions of the Bay late in the summer are dead. The crabs were able to swim into the pots but somehow were killed after being trapped. These observations prompted the Institute to undertake a study of the distribution of dissolved oxygen in the region. The results showed an oxygen poor layer in the lower depths of the region and suggested that the crabs might have been asphyxiated. No information could be found, however, concerning the oxygen requirements of the Blue Crab. This information is now being obtained, in cooperation with the Maryland Department of Research and Education, in a series of measurements in which the oxygen requirements at various water temperatures and salinities are being determined.

In summary, The Chesapeake Bay Institute's activities included (1) the training of oceanographers, (2) fundamental physical and chemical studies on the Bay and (3) cooperative programs with neighboring institutions in which the research facilities of the Institute and the specialized training of its staff have been used to advantage in the solution of many practical problems connected with the Bay fisheries. These activities will be continued and the program in basic ecology of the plankton of the Bay region which has been started will be further developed.

Students are encouraged to investigate the educational opportunities offered by the Institute and the University, and the facilities of these groups are available to advanced workers interested in problems that fit into the overall operations of the Institute.

Reference: Lucas, C. E., 1947. The ecological effects of external metabolites. Bio. Rev. Cambridge Phil. Soc. 22, 270-295.

Narragansett Marine Laboratory

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THE Narragansett Marine Laboratory of the University of Rhode Island is situated on the west shore of Narragansett Bay, two and a half miles from the mouth of the Bay. The physical plant consists of the following: a 10-room stone building containing laboratories and offices; a frame building with six small laboratories and a large central room equipped with running sea water, aquaria, water table and concrete tanks; dock and small boat basin; the 75 ft. research vessel *Seahorse*, and apparatus and facilities for all types of oceanographic research. In addition the Laboratory is now converting a third building to research in sedimentology and physical oceanography. Two vessels, an 88 ft. oyster boat and a 38 ft. dragger, are chartered and a 36 ft. LCVP is on loan from the Navy.

The permanent staff of approximately 30 includes biological, geological and physical oceanographers, technicians, vessel captains and administrative assistants.

In the prewar years the Laboratory only operated as a summer biological station and concentrated on marine fisheries problems. Among these were an investigation of the starfish *(Asterias forbesi)* populations of Narragansett Bay and their seasonal movements, a study of the biology and migrations of winter flounder *(Pseudopleuronectes americanus)* in the Narragansett Bay area, the role of salt ponds in the natural economy of Rhode Island waters and the development of a new fishery based on offshore stocks of the black, ocean or mahogany quahaug *(Artica islandica)*.

In 1949-51 the Laboratory greatly expanded the scope of its research program as well as its size, facilities and staff, and developed a graduate curriculum leading to the Master of Science in Biological Oceanography. Five of the current research projects are financed by contracts with the Office of Naval Research and the U.S. Navy Hydrographic Office.

The Laboratory's research programs in physical oceanography and marine geology have been closely integrated since their inception. The first joint project, a physical and geological survey of Narragansett Bay and an adjacent off-shore area of 900 sq. miles, laid the foundations for subsequent oceanographic investigations of all types in local waters. Detailed information was obtained on the nature of sediments and their lateral distributions, and on seasonal changes in water temperature, salinity, density, transparency and dissolved oxygen, at all depths.

From this survey sprang two of the Laboratory's major current projects, each of which combines physical and geological oceanography. One of these is concerned with the acoustic properties of marine sediments. By methods involving deep coring and the use of explosives, the attenuation of sound in various types of sediments is being studied *in situ*. In a separate project, a team of marine geologists and physical oceanographers is investigating the dynamics of sedimentation in local estuarine and coastal waters. Here again new methods are employed, and a penetrometer of original design has been constructed for *in situ* measurement of the degree of compaction of marine sediments. This information is essential in the solution of biological problems involving endemic pelagic and benthonic animal populations.

Current biological investigations involve the phytoplankton, zooplankton, nekton and benthos, and range from the neritic province to the open ocean. The major long term projects under way at present follow. *Underwater sound of biological origin.* The character and significance of sounds made by marine animals are being studied both in aquaria and in the natural environment. Recordings and analyses have been made of sounds produced by 62 species of fishes from temperate coastal waters, 105 subtropical and tropical fishes, 20 crustaceans and 2 species of marine mammals. *Open ocean zooplankton.* A two-year series of weekly zooplankton samples collected by the U.S. Coast Guard Weatherships at two Ocean Weather Stations in the North Atlantic is being analyzed. Since the collection sites are far removed from terrestrial influence—one in Davis Strait between Labrador and Greenland, the other in the Sargasso Sea—an unparalleled opportunity is afforded to ascertain the seasonal changes in the surface zone zooplankton in open ocean waters and to compare a boreo-arctic with a subtropical population with regard to standing crop and productivity. *Benthonic productivity.* Because of its abundance and ecological importance, the hard clam or quahaug *(Venus mercenaria)* serves as an index of biological productivity in the benthos of Narragansett Bay. Following an intensive survey of the distribution of the quahaug in the Bay, the influence of water properties and sediment type on the growth rate of this

animal are being analyzed. *Ecology of salt and brackish ponds.* Bordering Narragansett Bay, the Rhode Island coast is marked by a series of salt and brackish ponds exhibiting considerable variation in physical and chemical factors and in the character and abundance of their flora and fauna. Two of these ponds, representing contrasting types, are being studied with reference to basic phytoplankton, zooplankton, benthos and nekton productivity, and hydrographic, geological and chemical environmental factors. *"Trash" fishery.* An important fishery based upon a variety of marine fishes that formerly had no commercial value affords an excellent opportunity for a study of the biology of a complete population. The initial investigation has as its objective a determination of species composition of the populations involved, seasonal changes, and the sources of the different stocks.

Candidates for the Master of Science in Biological Oceanography devote their second year to the preparation of a thesis. Some of these students have been engaged in one or another of the projects outlined above; theses problems of others have involved studies of the phytoplankton and the zooplankton of local waters, the distribution and food of the herring *(Clupea harengus)*, the ecology of the sand-collar snail *(Polinices duplicata)*, and bacteria-plankton relationships.

A Clam Investigations Unit of the U.S. Fish and Wildlife Service, permanently stationed at the Laboratory, is pursuing an intensive investigation of the quahaug population and its fishery in a heavily fished area, for the purpose of developing a management policy.

The Narragansett Laboratory's research policy is to conduct investigations on basic problems in the several fields of oceanography. In so far as is possible the various projects are correlated to give an integrated picture of physical, geological and biological processes. As part of a state university, the Laboratory serves also as a fact-finding agency in oceanographic problems of practical importance to the state and will make recommendations when requested, but it is not directly involved with fisheries management policy or technological studies. The bulk of the Laboratory's literary output to date has been in the form of scientific reports to the Office of Naval Research.

Louisiana State University Marine Laboratory

HARRY J. BENNETT, *Director*

THE Louisiana State University was established as a teaching adjunct to the Department of Zoology in 1931. Prior to that time students in the department had been taken on extended field trips along the coast and these trips led to the realization that a permanent teaching facility would be of value to both students and staff. All of the possible sites on the coast were taken into consideration and Grand Isle, a small coastal island, was chosen. This island is located on the western side of Barataria Bay and is approximately 45 miles northwest of the Passes of the Mississippi River. When selected it was relatively isolated in that it could only be reached by boat. It is now connected to the mainland by a causeway and can be reached over a paved highway. The island was and still is the center of a thriving fishing industry.

Initially, students and staff were housed in tents and the local school building was used as the laboratory. The site of the present laboratory was purchased in 1934 and the first building was erected in 1936. Tents were used for housing until 1947 at which time a dormitory for men and six small huts for women students and staff were provided. Present facilities are adequate for a total of 15-20 students, independent investigators and staff.

Course work is offered for a six-week period beginning with the summer session. The courses available are: General Field Zoology for sophomores who have had one year of Introductory Zoology; Marine Biology for junior, senior and graduate students; and Problems in Marine Biology for those who have had one of the above courses or its equivalent. The work is so planned that the student scheduling General Field Zoology or Marine Biology will spend one-third of his time collecting and studying in the field; another one-third occupied with formal instruction, and the remainder on a problem of interest to the student. The time spent in the field is under the direct supervision of a staff member and a wide variety of habitats are studied. The student scheduling Problems in Marine Biology devotes his entire time to research.

The faculty consists of one professor and three graduate assistants. In addition, visiting investigators and staff members of the Departments of Zoology and Botany contribute to the program.

While the laboratory is operated only for the six-week summer period, it is available at all times for field trips and to independent investigators. Classes in botany, geology and zoology from this university are frequently taken to the laboratory for extended field trips and it is used for similar purposes by other educational institutions of the state.

The region is unique in that it is estaurine and it presents many opportunities for research, particularly in the fields of botany, geology and zoology. Grand Isle is so situated that it provides easy access to a large area west of the Mississippi River. Barataria Bay and numerous small bays which cover approximately 400 sq. miles, lie immediately to the north of the island. These bays average approximately 4 ft. in depth and many small islands, which rise only a few inches above mean low tide and which may be flooded at high tide, are interspersed throughout them. Their bottoms, for the greater part, consist of a soft muck of organic origin but in some areas the bottoms are sandy and are sufficiently firm to support bottom-dwelling forms of life. The prevailing southerly winds force much of the water discharged by the Mississippi River into the bays and large volumes of fresh water from the hundreds of square miles of marshland lying south of New Orleans between the Mississippi River and Bayou Lafourche flows into the bays also. As a consequence, salinities vary greatly. At times, particularly in the late winter and spring, the upper bays may be entirely fresh or only slightly brackish. Salinities in the vicinity of Grand Isle will vary from about 15 to 30 parts per thousand.

The coastal islands are little more than large sand bars although all of them are covered with vegetation. Grand Isle is quite typical of these islands. It is about 9 miles long, 1 mile in width, and rises no more than four ft. above sea level. The beach consists of shifting sand. Sand dunes which account for the greatest elevation lie immediately behind the beach. From this point the island slopes very gradually to the small bays and bayous at its back. A live oak climax forest covers some two square miles near the center of the island. Sand-meadows cover the ends while a salt-water marsh of varying extent is located along the northern shore. These coastal islands, small landlocked bays, and marshes traversed by hundreds of bayous fringe the coast from Mississippi to Texas. The shifting sands of the beaches, the mud and sand-mud flats behind the islands, the sandy to mucky bottoms, and the hundreds of square miles of marshland provide habitats for a vast array of invertebrates and vertebrates, and plant life.

Oysters are extensively grown in this region, the annual shrimp catch is greater than that for any other section of the country,

and there is found here also a wide variety of both game and commercial fishes. The marshland abounds with muskrat, nutria, mink, raccoon, alligators, turtles and snakes, and provides a wintering ground for tremendous numbers of water fowl. This section of the state produces vast quantities of salt, sulphur, oil and gas. The ecology of the region is being changed by these industrial operations and many problems that can be solved only through scientific investigations have arisen.

The entire region is subsiding slowly and this condition adds much interest to the area. As subsidence continues waters of higher salinity intrude as the coastline regresses and changes in all habitats result. The succession of animal and plant life under these conditions is of considerable interest to taxonomists and ecologists.

The anomalous situation represented by the building of new land by the sediments discharged by the Mississippi River and the loss of area through subsidence has many facets of interest to geologists. Studies relative to sedimentation, stratigraphy, fossil formation, coastal erosion and regression, obliteration of lakes and bayous by ecological succession, location of old bayous completely obliterated as water courses and location of old beach lines are some of the problems that are receiving attention at the present time.

The laboratory has served principally as a teaching institution and plans are being made to enhance its usefulness in this respect and to increase its facilities for research. The research that has been done largely pertains to the taxonomy, distribution and ecology of the local fauna. Its major contributions have been published in a series of papers, *Occasional Papers of the Louisiana State University Laboratory*, which is available on request.

The Winona Lake Biological Station, Indiana University

DAVID G. FREY, *Director*

THE Biological Station of Indiana University at Winona Lake has the distinction of being one of the oldest in the United States, having been established in 1895 by Carl H. Eigenmann, then head of the Dept. of Zoology. Eigenmann was intensely interested in the problem of evolution. He believed that a statistical study of the variation among non-migratory animals in a restricted and relatively stable habitat, such as a lake, compared from one year to another, and from one lake to another differing in environmental conditions, would give some insight into variation on which evolution was based. The Biological Station was established for this purpose, and in the words of the first annual report, "We have attempted to collect specimens of the higher creatures in such numbers and sizes, that had we collected all the specimens in the lake, our results would not be different."

Originally the Station was established on Wawasee (or Turkey) Lake, in the northeast corner of Kosciusko County in northern Indiana; the idea being that after several years of intensive work on this lake, the Station would be moved to another lake where comparable and comparative studies would be made. In 1899 the Station was moved to its present site on Winona Lake, a short distance east of the city of Warsaw.

The early work at Wawasee resulted in detailed studies of the physical features and temperature distribution in the lake, preparation of a hydrographic map and studies on the plankton (by Chancey Juday), and later studies on the bottom fauna. There were detailed taxonomic studies on annelids, rotifers, Cladocera, decapods, Odonata, Mollusca, water mites, etc., and all the classes of vertebrates except aquatic mammals. Eigenmann even planned to construct automatic recording devices for the study of seiches. Hence, although chiefly interested in the process of evolution, Eigenmann had planned and was carrying out a quite complete (for that time) limnological study of a single lake. Similar studies were later made on Winona Lake.

Thus the Station started out as a center for limnological research and it has so continued.

According to the agreement with the University Trustees, the Station was to be self-supporting. Eigenmann was compelled, therefore, contrary to his desires, to give a series of courses at both elementary and advanced levels to help defray expenses. Each of the advanced students and instructors, eleven in all, was assigned to some particular part of the survey.

The year after the Station was transferred to Winona Lake, Mendel's studies on heredity were rediscovered. Eigenmann forthwith abandoned his statistical studies on variation. One of his students and co-workers, W. J. Moenkhaus, began experiments on the hybridization of fishes to test these new principles. Eigenmann himself turned his attention more and more to a study of degenerative evolution, as exemplified by cave vertebrates.

Teaching became a progressively more important function of the Station. At the turn of the century there was a varied program of instruction in zoology, botany and bacteriology. Somewhat later only zoology courses were offered, and the Station was truly an integral part of the Dept. of Zoology. Summer courses in zoology were not given at Bloomington but only at the Biological Station until 1936. Beginning in 1938, however, instruction at the Station was discontinued.

Eigenmann remained director until 1910. Fernandus Payne was then director until 1920, Will Scott until 1937, W. E. Ricker until 1950, and the writer since that time. The dominant interest of these persons (except Payne) in the freshwater habitat and its processes has largely controlled the over-all research activities carried out at the Station.

Aquatic studies are encouraged and facilitated by the location of the Station. In Kosciusko County there are approximately 80 lakes with an area of five acres or more, including the State's largest natural lake (Wawasee: 2964 acres) and the deepest (Tippecanoe: 123 feet). Smaller lakes in various stages of senescence bring the total to over 100. These lakes are all located within 15 miles of the Station. Besides lakes, there is a variety of clearwater and turbid streams available. The topography of the county is glacial in origin, consisting chiefly of morainal hills and outwash plains. Much of the land is used for agricultural purposes, although a considerable part, particularly around the lakes, is covered with mixed deciduous hardwoods.

Besides the limnological and faunistic studies already mentioned, there have been numerous other limnological studies by Will Scott and his associates (T. B. Rice, W. R. Allen, Herman Spieth, Ralph Hile, S. C. Denham, and others), plus studies on the food and growth rate of fishes. In several of the nearby lakes W. E. Ricker carried on his detailed investigations of the structure and growth of fish populations and the rates of their exploitation, which have lead to the adoption by many states of a continuous open season on panfish.

Pioneer work on the process of sedimentation in lakes using collectors (by Scott and Miner) and on the accumulated sediments of lakes (by Ira I. Wilson) were carried on out of this laboratory. The interpretation of the ontogeny of lakes from their accumulated sediments is the major research interest of the present director.

S. D. Gerking, also of Indiana University, is currently studying the rate of utilization of food by natural fish populations. In addition, several graduate students have been using the Station for various limnological problems leading to the M.A. or Ph.D. degree.

From Will Scott's time up to 1953 many of the research activities at the Station were supported by and carried out for the Indiana Dept. of Conservation. Results of many of these studies were published at irregular intervals in *Investigations of Indiana Lakes and Streams*. Although there is no longer a work contract between the University and the Dept. of Conservation, publication of the *Investigations* is continuing under University sponsorship.

No courses are offered at the Winona Lake Station at present, and very likely none will be in the foreseeable future. The Station is used exclusively as a research center for graduate students and faculty. The facilities are available without charge to visiting investigators who wish to work on specific problems. The director should be contacted well in advance so that suitable arrangements can be made.

The Biological Station consists of three two-story frame buildings, each 20 x 45 ft., on the east shore of the lake. One of these, designated as the laboratory, is winterproofed for cold

weather work. It contains a very serviceable chemistry laboratory with an electric still, three large biological laboratories, plus two smaller rooms for individual investigators. Another building is essentially a summer dormitory for males, with all the necessary facilities including kitchen accommodations. The third building is used for the storage of bulky supplies and equipment. Most items of field and laboratory equipment are transported back to Bloomington each fall for use at the University during the regular school year.

The Station is readily reached by automobile, bus, or train. It is only a mile south of highway U.S. 30, along which there is a frequent schedule of buses between Chicago and the eastern states. The city of Warsaw is on one of the main east-west lines of the Pennsylvania Railroad.

Mount Desert Island Biological Laboratory

WARNER F. SHELDON, *Director*

THE Mount Desert Island Biological Laboratory, a summer marine laboratory located on the coast of Maine, is owned and operated by an association of scientists and designed to provide basic facilities for research.

Mount Desert Island has long been world famous for its scenic beauty and agreeable summer climate. The Island lies in the Gulf of Maine about 150 road miles east of Portland, Me., and is connected to the mainline by a bridge. The land area of more than 100 sq. mi. features a range of bold ice-eroded mountains that form a belt across the center and a narrow natural fiord 6 mi. deep that partly divides the east and west halves. Between the mountains lie numerous deep fresh water lakes and shallow ponds. Much of the mountainous area is part of Acadia National Park and is protected against human depredations. The Island lies near the mouth of the Bay of Fundy and is separated from the mainland and adjacent island by deep narrow bays. Strong tides average 10 to 12 feet.

The biological resources of the Acadian area are readily available. In summer the cold waters of the Gulf of Maine are extremely rich in marine life. The rocky shores, mud flats and strong tidal currents provide a large variety of unusual forms. Proximity to fresh water lakes and ponds, and the mixed terrain give further diversity to the forms available for experimental purposes.

The Laboratory was founded as The Harpswell Laboratory in 1898, by J. S. Kingsley of Tufts College. In 1921 it was moved to Mt. Desert Island and its present name adopted. The original land at Salisbury Cove, known as the Weir Mitchell tract, was a gift from the Wild Gardens of Acadia. The present development in land, buildings, and equipment has been the result of many generous contributions by summer residents of the Island. Operating revenue derives from laboratory fees, cottage rentals, membership dues, and scientific grants from governmental, industrial, and private sources. Capital improvements are usually dependent upon the receipt of special gifts.

The Laboratory is situated on a tract of about 150 acres, fronting on Frenchman Bay at Salisbury Cove, in the Township of Bar Harbor. This rural village is in the more level open part of the north shore of the Island. Besides shore frontage, the Laboratory owns part of a good-sized fresh water pond and brook, and its land varies from forest to meadow to bog.

Laboratory buildings are equipped with the basic facilities for research. There is running salt and fresh water, electricity, Pyrofax gas, compressed air, a marine dock, power boat, aquaria, live-cars, dark room, refrigerated and clinical centrifuges, torsion and chain-o-matic balances, electric ovens, sterilizer, incubators, Beckman pH meter, colorimeter, Baird flamephotometer, Warburg apparatus, basic chemicals, glassware, smaller apparatus, and collecting equipment, Investigators bring their own specialized equipment and chemicals. Individual research rooms are rented for the season, roughly June 15 to September 15. The fee is ordinarily paid by the Investigator's home University or from a grant. Each worker is entitled to the general facilities of the Laboratory but special arrangements are necessary if unusual demands are anticipated.

Fellowships supported by the Ulric Dahlgren Memorial Fund and by the National Science Foundation are awarded annually to research workers or their assistants. Awards can be used to meet laboratory fees, living or traveling expenses.

Fourteen cottages suitable for families with children stand on land owned by the Laboratory. All are within easy walking distance of the Laboratory Point itself. These cottages are available for rental to workers by the season or sometimes half-season. Single investigators and couples without children rent rooms in the village and take their meals in the Laboratory Cooperative Dining Hall.

Mt. Desert Island and environs is the summer home of many well known scientists. Proximity to the two divisions of the Jackson Memorial Laboratory adds to the scientific resources. Salisbury Cove is an old fishing and farming hamlet on the north shore of the Island. The Laboratory colony itself usually comprises about 75 adults and 50 children of assorted ages, the whole numbering a sizeable percentage of the summer population of the village. Bar Harbor proper, about 6 mi. from the Laboratory, contains most of the services of a city. The widely publicized fire of 1947 did not touch the Laboratory area, nor were its visible effects on the Island as serious as might be supposed. For a biologist the ecological changes produced by this fire are of great interest.

In recent years the bulk of Laboratory personnel have been drawn from the biological and medical fields. Many types of scientific backgrounds are represented and this diversity of scientific training, interests, and skills is one of its greatest assets. The relaxed unhurried atmosphere provides unusual opportunities for discussion, consultation, and cooperative research. In the Laboratory or at play, conversations inevitably return to "science" in its broadest aspects or its infinite detail. Real benefits to science in general, and to the participating investigators in particular, result from the broadening of outlook occasioned by easy interchange of techniques and philosophy.

In the past the Laboratory has ventured sporadically into formal undergraduate teaching. At present the members of the Laboratory feel that our educational work should be aimed at training in research, graduate students who plan careers in biology or medicine. The student serves as a member of a team, learning research methods and techniques through actual participation in the work of a small group led by an experienced investigator.

Studies of renal function carried out at the Mt. Desert Island Biological Laboratory by Drs. Homer W. Smith, E. K. Marshall, Roy P. Forster and many others over the last 30 years have won world renown. In many instances the basic research has been uniquely indebted to the opportunities presented at this Laboratory. These studies have culminated in the development of methods for measuring the rate of glomerular filtration, renal blood flow, and tubular function in man as well as in the experimental animals. In recent years nearly half of the total laboratory personnel have been working in this field. Many lectures and informal seminars of special interest to these workers are conducted by men who are the acknowledged leaders. Experts in a variety of allied fields are readily available for consultation or cooperative research. This provides a unique opportunity for the young research worker to get advice and help.

Scientists who come to Mount Desert Island during the summer months are cordially invited to visit the Laboratory and attend scientific meetings.

Michigan State University

Kellogg Center, *one of the new, modern buildings on the Michigan State University campus. It is the center for Continuing Education Service, contains conference rooms, banquet facilities and hotel accommodations for approximately 300 persons. Some Society activities will be held in Kellogg Center during the September meetings.*

MEETING OF BIOLOGICAL SOCIETIES

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MICHIGAN STATE COLLEGE

East Lansing, Michigan

September 5-9, 1955

INFORMATION ON HOUSING

DORMITORY ACCOMMODATIONS: College dormitories will be available for housing couples and families as well as single delegates. Accommodations will be available also in hotels and motels in and around the cities of Lansing and East Lansing. However, reservations for these accommodations will not be handled by MSC officials and arrangements must be made by individuals directly with the hotels and motels. Hotel-type accommodations are provided in the Kellogg Center on the MSC campus. These rooms, however, are limited in number and assignment will be made on a first-come first-served basis. Reservations may be made through Mr. J. D. Jackson whose address appears below.

DORMITORY ROOMS MAY BE OCCUPIED: Any time from noon on Monday, Sept. 5 until 10:00 a.m. Friday, Sept. 9.

PRE- AND POST-MEETING HOUSING: Arrangements should be made individually by delegates through Mr. J. D. Jackson whose address appears below.

RESERVATIONS: Dormitories and Kellogg Center—May be made from now until Sept. 2. Payment is to be made at time of registration on MSC campus.

RATES: Per person in *dormitories* (two persons assigned to a room), $3.00 per person the first night and $2.00 per person each additional night, with a maximum charge of $12.00 per week per person.

Per person in *Kellogg Center* (two persons assigned to a room), $3.50 per person per night.

ACKNOWLEDGMENT: Each advance reservation received before August 27 will be acknowledged by a form which should be presented at the registration desk in September. **Registration will be in the Main Lobby of the MSC Student Union.**

MEALS: Those staying in regular dormitories will take their meals in their "home" dormitory cafeterias. The cost will be $3.50 per day, payable in advance at time of registration. The cost of a missed cafeteria meal may be applied toward the cost of a banquet if arrangements are made during the registration period at a special "exchange" desk which will be provided for this purpose.

Those not wishing to take advantage of this "package" rate for meals may be served in the MSC Student Union Cafeteria on a direct cost per meal basis. However, each person making this choice should bear in mind two facts:

1. All delegates who select the individual, or "non-package" payment plan for their meals must be assigned to special dormitories set aside for this purpose.

2. The cost of meals on an individual basis will be higher.

Delegates will pay for and receive banquet tickets at registration.

TO MAKE ADVANCED REGISTRATION: Please fill out the registration form and mail to:

J. D. Jackson, AIBS,
Continuing Education Service,
Michigan State College,
East Lansing, Michigan.

TO FACILITATE ASSIGNMENT OF ROOMS: Those wishing to room together are requested to indicate this on the housing application form or on a note attached to the housing application form.

(PLEASE TYPE OR PRINT ALL INFORMATION)

REGISTRATION AND HOUSING APPLICATION—MSC MEETING

Name..... Male ☐ Female ☐
(FIRST) (MIDDLE) (SURNAME)

Home Address:.....
(STREET)

.....
(CITY) (ZONE) (STATE)

Full Names, Sex, Relationship of Members of My Party:

.....

.....

.....

Professional Address:.....

Title:.....

Institution:.....

Society Membership:

(1).....

(2).....

(3).....

Remarks:.....

.....

Expected Time of Arrival:.....
(DATE, HOUR)

Departure:.....
(DATE, HOUR)

Arrival: By Train ☐
By Plane ☐
By Car ☐

Please make reservations for me (and my party) in:

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Dormitories without meals: (non-package rate) ☐

Kellogg Center: ☐

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